# Bergvesenet

Postboks 3021, 7002 Trondheim

# Rapportarkivet

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**Tittel**

Mise-á-la masse potential measurements, Espedalen

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| Geofysikk | Rapport | Evan, Jørstad, Statsråd Stang |
| **Råstofftype** | **Emneord** | |
| Malm/metall | Ni Cu | |

**Sammendrag**

Oversatt til engelsk

FOR:

FALCONBRIDGE NIKKELVERK A/S

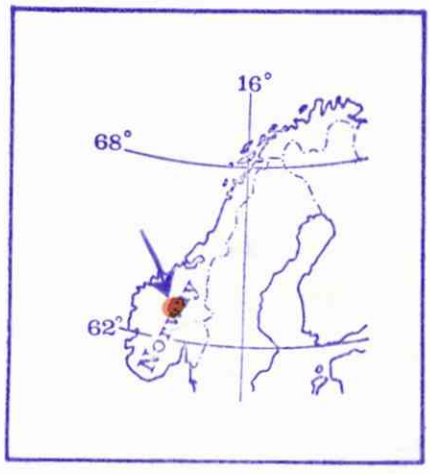
NORSK HYDRO A/S

A/S SULFIDMALM

PROJECT 905-15

# MISE-Á-LA-MASSE POTENTIAL MEASUREMENTS, ESPEDALEN, AUGUST 1971.

A. SINDRE, NGU



## INTRODUCTION

In the summer of 1971 NGU was given a contract by Norsk Hydro A/S to carry out mise-á-la-masse measurements over 3 deposits in Espedalen. (Statsråd Stangs Mine, Evans Mine and the Jørstad deposit). It was suspected that the ore bodies were long, plunging, pencil shaped bodies and the main interest was to find out the extent of the down plunge direction for possible later drilling.

## SHORT DESCRIPTIONS OF THE DEPOSITS

In earlier times there have been several periods of mining of the ores at Statsråd Stang and Evans, and several geological and geophysical investigations have been carried out later. Diamond drilling has been carried out on the Jørstad deposit. The geology of the area and the form of the mineralization is reasonably well known.

The deposits lie in an anorthosite-norite thrust sheet on the north side of the lake Espedalsvannet. The ore in the two mines is nickel-copper-pyrrhotite, containing 30-70% sulphides. Both deposits are in direct contact with and at the base of ultramafic bodies. At Statråd Stang, the ore has a strike length of approximately 120 m and a thickness of 1-3 metres. The ore body's dip is approximately 45° N.

At Evans the ore has a strike length of 150 m and a thickness of 0,5 - 3 metres. The ore body plunges approximately 25° N. At Jørstad the mineralization is better described as impregnation ore, containing more massive sections.

At Statsråd Stang and Evans the upper 30-40 m of the ore bodies have been mined out. At Jørstad there has been no significant development.

## FIELD METHODS

The mise-á-la-masse method consists in short of sending an electric current through the ground from one earthed contact directly in the ore body and the other earthed contact as far away as possible, such that no interference from it is present within the survey area. The potential field is measured on the surface. From the potential map obtained, one can draw conclusions on the ore body's size and geometry. A precondition for the successful use of this method is that the ore body should be an electric conductor such that the fall in potential within the ore body is very small. Thus it is insignificant where in the ore body initial contact is made.

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The instrument that was used in Espedalen was made for NGU by geophysicist Per Eidsvig. The system consists of a current source which is a gasoline driven generator; rectifier; pulse generator, which divides the current up in pulses with intervals between current; and instruments for measuring the actual potential. The current source, the rectifier and the pulse generator are kept at one place, and the measuring instruments are moved in the field during measurements.

The measurements are carried out by measuring the potential difference between two and two points which are moved in series along the survey line. The period when the current is off, is used for compensating the instrument for possible self-potential in the ground. The potential difference is obtained by summing up the potential differences from a chosen starting position.

In Espedalen the distant electrode was placed in Breisjøen, approximately 5 kms from Statsråd Stangs Mine and approximately 7,5 kms from the Evans and Jørstad deposits. The second current electrode was grounded directly in the ore at the deposits to be investigated. At Statsråd Stang and Evans the electrodes, which consisted of aluminium foil and copper wire, were laid against mineralization in the bottom of the water-filled pits, and at Jørstad a 2 m long copper pipe was lowered down drill hole No. 4. The best contact was obtained at a depth of 10-11 m where the core logging had shown a zone of more massive mineralization.

For use as a grid, base lines were set up beforehand. The grid was laid out with the help of measuring bands and compass in the area immediately around the ore's outcrop. At the extremeties of the survey area distances and direction were taken as the survey was under way and marked with red tape. The system worked well.

Spacing between stations along the profile was 25 and 50 metres. In all three areas a constant current strength of 1 Amp. was used. The current interval used to begin with was 6 seconds on and 2 seconds off. It was later decided to use 9 seconds on and 3 seconds off.

The survey was carried out by 5 men. The client provided 3 of these, Per Flaten, Finn Hansen, and Aasmund Ørvik. Two measuring teams, each consisting of two men, carried out the measurements, and one man observed the stationary equipment. The long cable was broken twice, once by people and once by cows, but delay on this account was small. Because of the large distances, good use was made of walkie talkie apparatuses. The whole survey was carried out under good weather conditions.

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## SURVEY RESULTS AND DISCUSSION

### Statsråd Stangs Mine

The survey results are shown on the enclosed map 1063-01. The potential pattern in this area is strongly influenced by other conductors than the ore body in Statsråd Stangs Mine. Inductive EEM. measurements carried out by Norsk Hydro A/S in 1969, show that the mineralized zones south, north and north-east of the mine, are good electric conductors, and this makes the picture more complicated and difficult to interpret.

The conductor lying immediately south of the mine has had an influence on the potential field such that it goes south from the mine at a very strong gradient. These two conductors probably have no electrical connection with each other. Even without the conductor to the south, a steep gradient would be expected to the south, since the ore body is supposed to be dipping towards the north.

The conductors which lie to the north, north-east and east appear to have a weak electrical connection with the ore body in the mine without there being any direct connections. These conductors have the effect of holding the potential relatively high in a larger area to the north, north-east and east of Statsråd Stang.

Certain information on the ore body at Statsråd Stang is thus difficult to obtain from these measurements. To get a better view, the survey profiles 500 E is shown in the attached figure 1063-04. The geology along the profile was measured by E. Overwien in 1964, and the heights along the profile were measured with a barometer by dir. Jacob Kielland. The ore body's plunge in relation to the survey surface is approximately 55°. If the potential curve immediately over Statsråd Stang is compared with curves obtained from model measurements over conductive plates with the same dip, it would appear that the ore body's axis must be at least 150 m. On account of the above mentioned interferences, the interpretation is very uncertain,

If the mineralization immediately north of the mine has had a relatively small influence on the potential picture, the ore body at Statsråd Stang would have a length down the plunge of approximately 200 - 250 m. To obtain more certainty in the interpretation it would be possible to make more potential measurements by earthing in the different conductors in the area. One would thus be able to define the relative sizes of the conductors and this would give a basis for deciding how much interference they have had on the potential field.

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Evans mine

The potential field for this area is shown on the enclosed map 1063-02. The highest potential is obtained as expected immediately over the electrode and the outcrop of the ore in the workings. The potential falls very quickly in all directions. The fall off is so strong that it is quite clear that this body has very small extents.

The fall off in potential is slightly less in the northern direction, and this indicates that the ore plate is dipping to the north. But the fall in potential is also so strong in this direction, that it is quite clear that the axis down plunge of the ore body is small. This agrees well with the results that Einar Overwien came to in his report from investigations in 1964 where it is mentioned that profiles measured across the ultrabasic which the ore body is connected with, show that it has a very small extent in the direction of dip of the ore.

At the end of the ore's outcrops the potential field also drops very quickly, approximately 7000 mV per 100 m. This shows that the ore zone does not continue beyond the known outcrop of the ore.

The potential picture obtained over Evans Mine indicates that that which remains of this ore body is of very small dimensions.

Jørstad deposit

The results of the potential measurements over this area are shown on the attached map 1063-03. The picture is here completely different from the two other areas. One has at Jørstad a large area where the potential remains at approximately the same level.

It would seem that there is an area of approximately 200 x 600 m outlined by the 200 mV contour where one has a good conducting medium. If in this area there is a somewhat homogenous conductor or one has a collection of good interconnected conductors, cannot be differentiated from the investigations made.

To determine the depth extent of the conductor or conductors, geophysicist Per Eidsvig carried out some simple model measurements. Comparison between the field measurements and the model measurements, shows that the depth extent is probably small in comparison to the lateral dimensions. One would thus expect that the plate or ore body's thickness is of a maximum order of 50 - 100 m. It is also possible that the thickness could be larger due to the presence in the immediate area of unknown conductors. The interpretation is also made difficult by the conductor just south of the ore body. The

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survey results indicate that there can also be a conductor slightly west of the deposit at 100 E and 300 N. This conductor must in any case have a poor electrical connection with the Jørstad deposit.

## CONCLUSIONS

From the investigations carried out it is difficult to come to any certain conclusions concerning the ore possibilities at Statsråd Stangs Mine. The measured potential in this area indicates that the ore body has an axial length of between 100 and 250 m. Suplimentary measurements with contacts in the surrounding conductors could lead to a more certain interpretation. It is also possible that the surrounding deposits could add significantly to the amount of ore in this area.

At Evans Mine the potential map shows that the ore body left in the ground, is of very small dimensions. Further work here cannot be recommended.

The Jørstad deposit is judged by far the most promising of the three investigated areas. Potential measurements have shown clearly that one has a conductor or collection of connected conductors, with an area of approximately 200 x 600 m. With the help of model measurements it has been indicated that the thickness of the ore body is probably between 50 and 100 m. It would seem natural that further work in the area should consist of diamond drilling to determine with more certainty the ore body's size and grade.

Trondheim, December 9th, 1971

NORGES GEOLOGISKE UNDERSØKELSE

Geofysisk Avdeling

Atle Sindre

Geophysicist

(Translated for A/S Sulfidmalm)

J.B. Gammon.

# A/S SULFIDMALM

INTER-OFFICE MEMORANDUM

**Date:** January 26th, 1972

**To:** Falconbridge Nikkelverk A/S

**cc:** A.M. Clarke/ D.B. Sutherland
D.R. Lochhead
R.B. Band

**From:** F. Hansen
Dir. Kielland, Norsk Hydro.

**Subject:**
From: J.B. Gammon

Norsk Hydro Joint Venture -
Mise-á-la-masse in Espedalen.

Please find attached an English language version of the report from NGU's geophysical department concerning these measurements. The objective was to determine the extent of known mineralised bodies beyond the worked areas. The method appears to have worked very well. On the basis of these results we can probably eliminate the Evan's deposit from further consideration. The results indicate that a considerable depth extent is probable for ore remaining in the Statsråd Stang deposit, the exact figure would lie between 100 m and 250 m, depending on the influence of adjacent conductors.

The most positive results are from the Jørstad deposit where indications are that a conducting area of 200 m x 600 m is present. Thickness estimates were of the order of 50 - 100 m. Taking a more conservative estimate of 30 m for the thickness, leads to a potential of around 10 million tons indicated mineralization.

I agree with Sindre's conclusion that further drilling is warranted at Jørstad. This will be discussed with Norsk Hydro when making plans for 1972 work in the Joint Venture.

J.B. Gammon

Nixon.
En annen metode
anvendelig i Espe-Svedland.

| MOTTATT 28. 01. 72 | | | | BESV. | ARK. |
|---|---|---|---|---|---|
| X | ADM. DIR. | | | FORSKN./UTV. | |
| | TEKNISK DIR. | | | EL. LYSEAVD. | |
| | PERSONALDIR. | | | M.L. AVD. | |
| | ADM. SJEF | | | R. & SM. AVD. | |
| | INNKJ. AVD. | | | EL.TEKN.AVD. | |
| | REGNSK. AVD. | | | INSTR. AVD. | |
| | SKIPN. AVD. | | | MEK. AVD. | |
| | SJEFMET. | | | PROSJ. AVD | |
| | | | | | |
| 3 | SAKSBEARB. Nixon AR | | | | SVARDATO |
| | | | | | |
| | | | | | |

200 Ø 400 Ø 600 Ø 800 Ø 1000 Ø

900 N
700 N
500 N
300 N
100 N
100 S
300 S

• Basis

N

TEGNFORKLARING:

Jordingspunkt, strømstyrke 1 Amp.

Målepunkt

Kontur intervall 250 mv

(Fjernelektrode i Breisjøen ca. 5 km borte

NORSK HYDRO A/S
POTENSIALMÅLINGER
„MISE Á LA MASSE"
STATSRÅD STANGS GRUVE, ESPEDALEN

NORGES GEOLOGISKE UNDERSØKELSER
TRONDHEIM

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| MÅLESTOKK 1:2000 | MÅLT | A.S. | AUG. 1971 |
| | TEGN. | A.S. | |
| | TRAC. | T.Sol. | NOV. 1971 |
| | KFR. | A.S. | DES. 1971 |

TEGNING NR: 1063 – 01

KARTBLAD NR: 1717 IV

0 200 Ø 400 Ø 600 Ø 800 Ø 1000 Ø 1200 Ø 1400 Ø

800 N
600 N
400 N
200 N
0
200 S
400 S

-23000
-24000
-22000
-21000
-20000
-19000
-18000
-17000
-16000
-15000
-14000
-13000
-12000
-11000
-10000
-9000
-8000
-7000
-6000
-5000
-4000
-3000
-2000
-1000
0 mv

TEGNFORKLARING:

Jordingspunkt strømstyrke 1 Amp.

Målepunkt

Kontur intervall 1000 mv

(Fjernelektrode i Breisjøen ca 7,5 km borte)

N

NORSK HYDRO A/S
POTENSIALMÅLINGER
„MISE Á LA MASSE"
EVANS GRUVE, ESPEDALEN

MÅLESTOKK 1:2000

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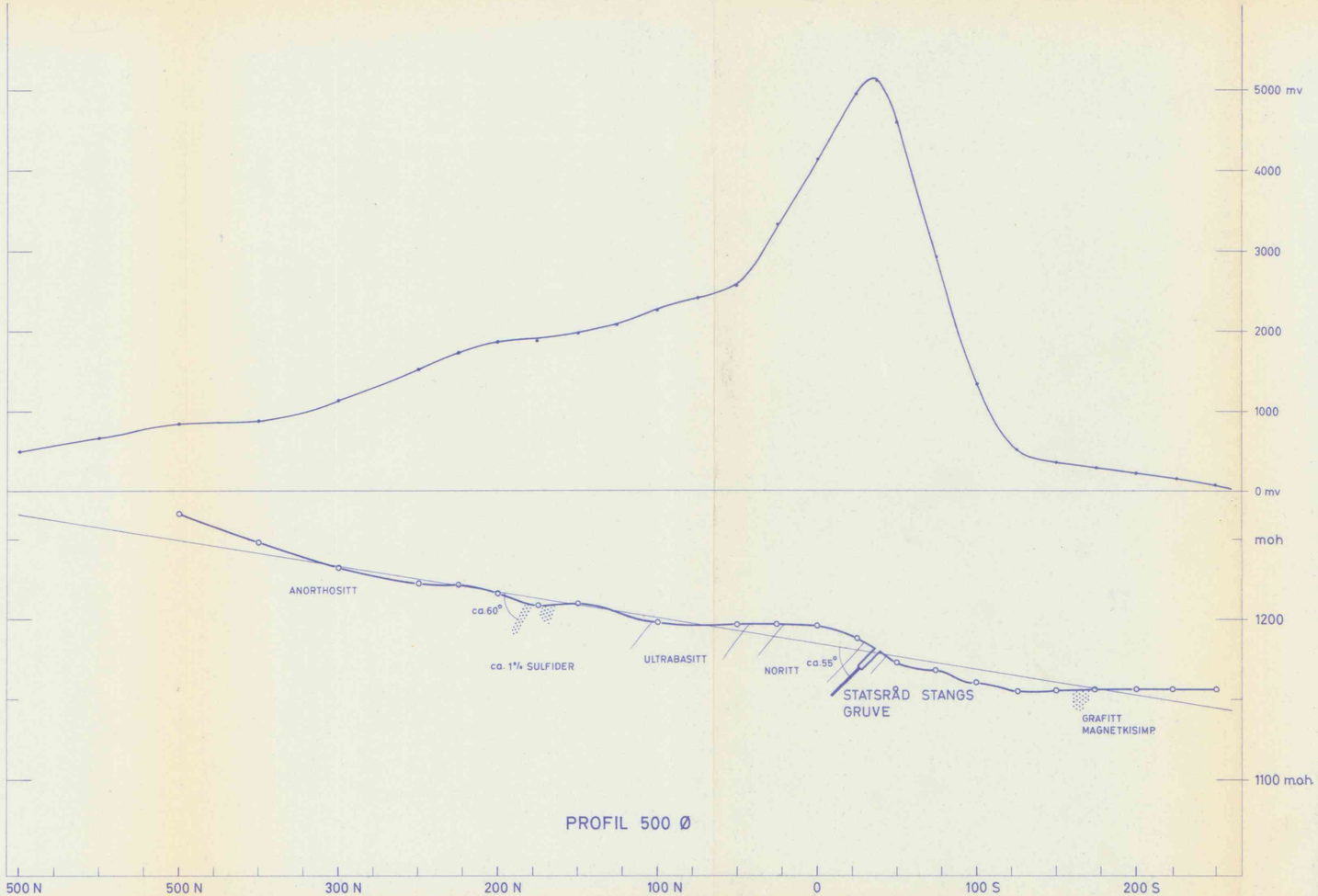
|---|---|
| MÅLT A.S. | AUG. 1971 |
| TEGN. A.S. | |
| TRAC. T.Sol. | NOV. 1971 |
| KFR. A.S. | DES. 1971 |

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

TEGNING NR 1063 – 02

KARTBLAD NR 1717 I




NORSK HYDRO A/S
POTENSIALMÅLINGER
„MISE Á LA MASSE"
STATSRÅD STANGS GRUVE, ESPEDALEN

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

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| MÅLESTOKK | MÅLT A.S. | AUG. 1971 | |
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| | TRAC T.Sol. | DES. 1971 | |
| | KFR. A.S. | DES. 1971 | |

| TEGNING NR: | KARTBLAD NR: |
|---|---|
| 1063-04 | 1717 IV |

200 V | 0 | 200 Ø | 400 Ø | 600 Ø | 800 Ø | 1000 Ø | 1200 Ø

700 N
500 N
300 N
100 N
0 Basis
100 S
300 S
500 S

-1000
-1050
-900
-800
-700
-600
-500
-400
-300
-200
-100
0 mv
80 mv
-950

Bh. 4

N

TEGNFORKLARING:

Jordingspunkt strømstyrke 1 Amp

Målepunkt

Kontur intervall 100 mv

(Fjernelektrode i Breisjøen 7,5 km borte)

NORSK HYDRO A/S
POTENSIALMÅLINGER
„MISE Á LA MASSE"
JØRSTAD FOREKOMST, ESPEDALEN

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

MÅLESTOKK 1:2000

MÅLT A.S. AUG
TEGN. A.S.
TRAS. T.Sol. NO
KFR. A.S.

TEGNING NR 1063–03

KART 17